

Supplementary information for

Average and extreme heatwaves in Europe
at 0.5–2.0°C global warming levels
in CMIP6 model simulations

by

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Climate Dynamics

Supplementary file containing Figures S1–S11

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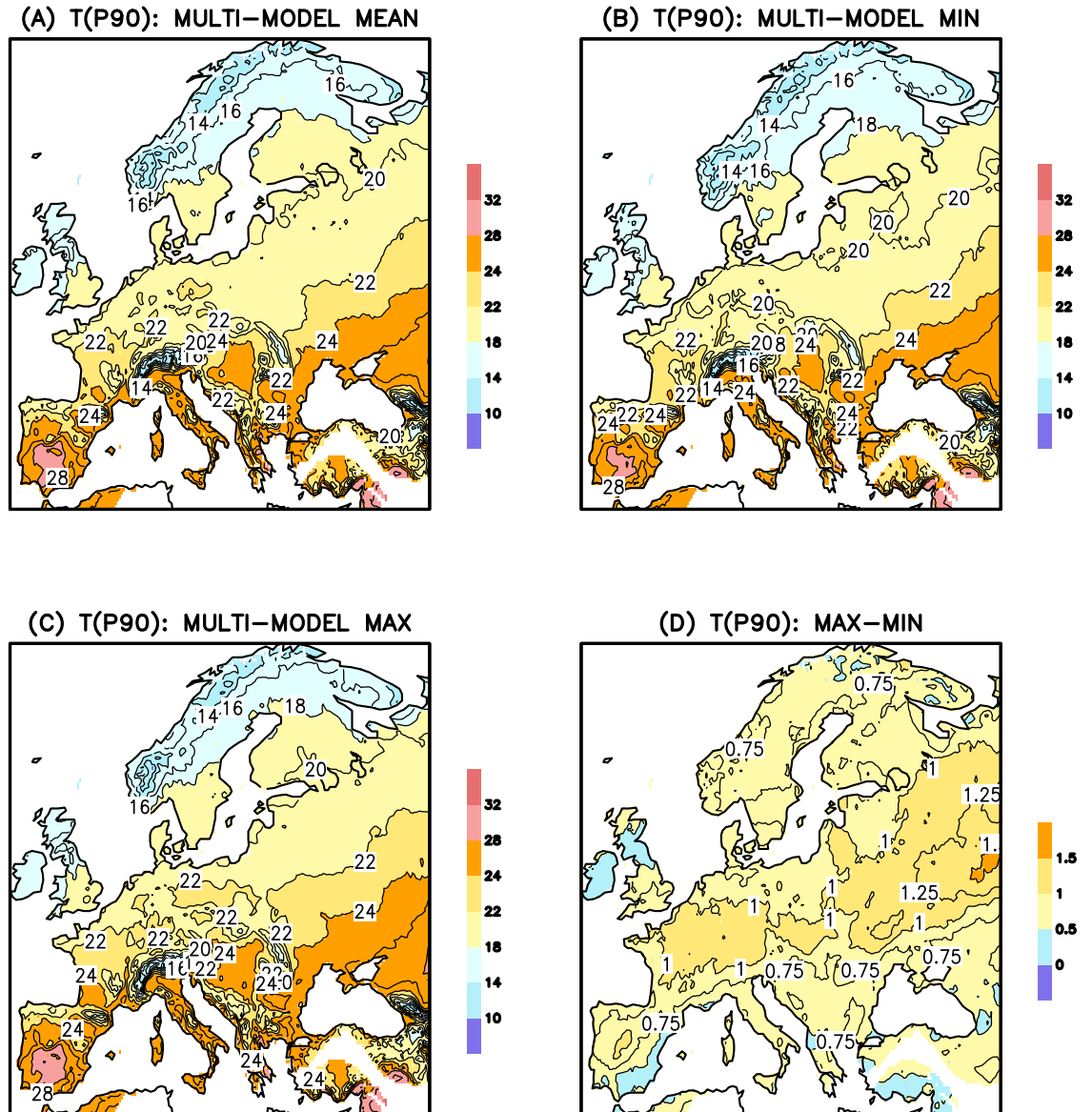


Fig. S1: The 90th percentile of bias-corrected summer (June-August) daily mean temperatures for the period 1961–2000: (a) multi-model mean, (b) minimum value among the models, (c) maximum value and (d) the difference between the maximum and minimum.

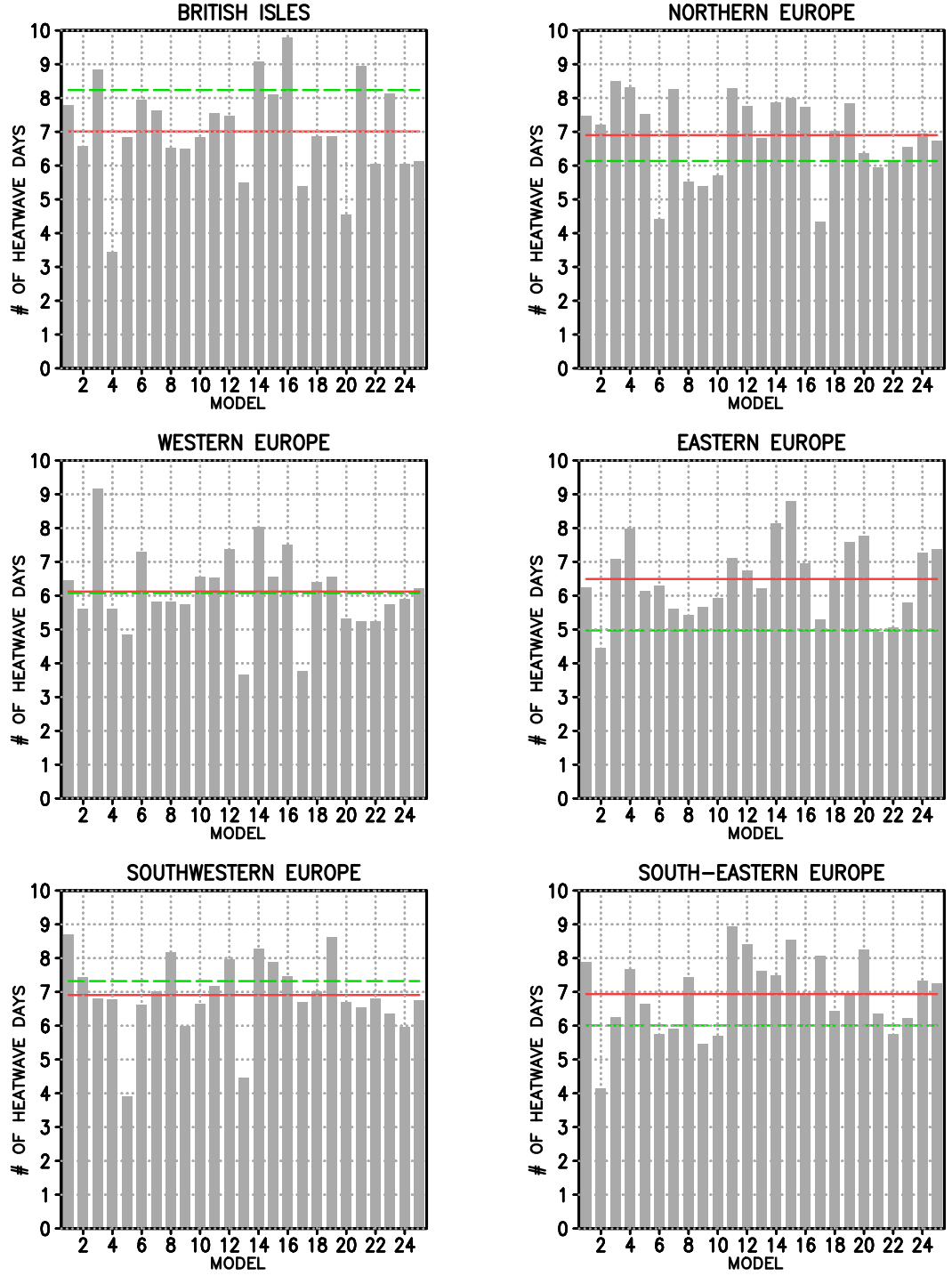


Fig. S2: The total annual number of heat-wave days above T_{p90} averaged over the six sub-regions shown in Fig. 4 of the main text. Temporal means over the period 1977–1996 for the individual GCMs (listed in Table 1 of the main text) are denoted by grey bars. The 25-GCM means are shown by red solid lines and the corresponding temporal means derived from the E-OBS analyses by green dashed lines.

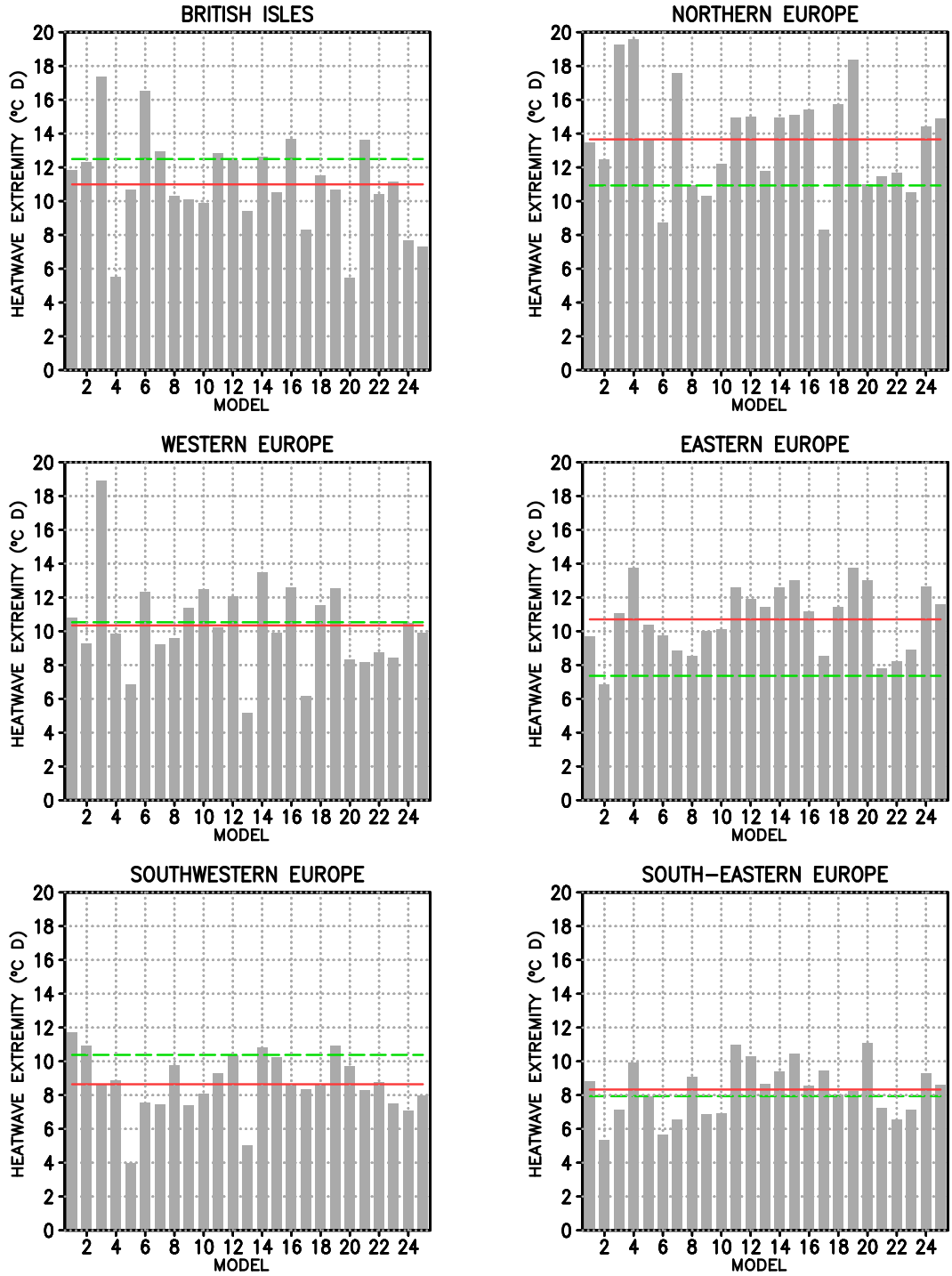


Fig. S3: The total annual heatwave extremity index (the sum of all heatwave events) above T_{p90} averaged over the six subregions shown in Fig. 4 of the main text. Temporal means over the period 1977–1996 for the individual GCMs are denoted by grey bars. The 25-GCM means are shown by red solid lines and the corresponding temporal means derived from the E-OBS analyses by green dashed lines.

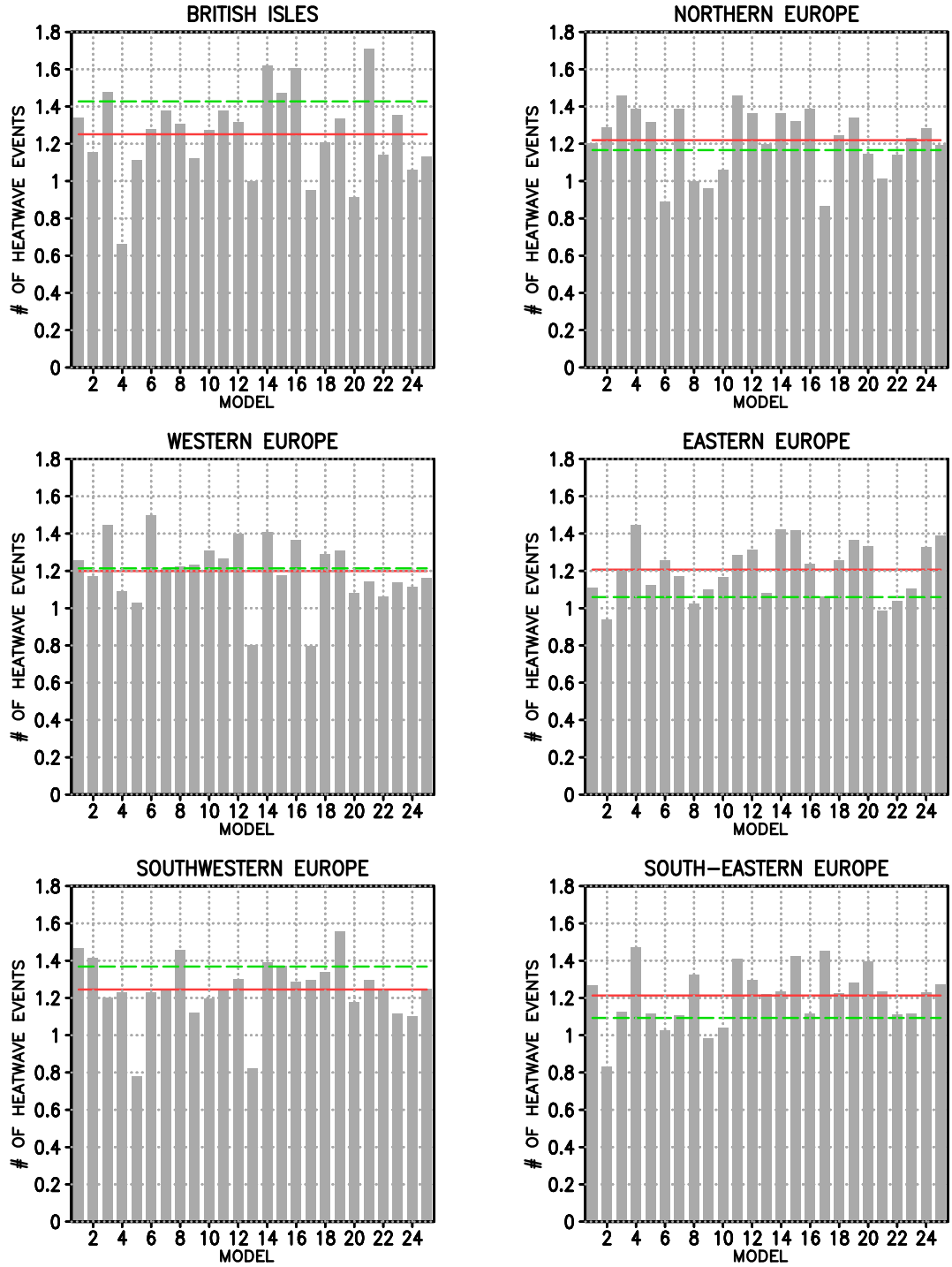


Fig. S4: The mean annual count of separate heatwave periods above T_{p90} averaged over the six subregions shown in Fig. 4 of the main text. Temporal means over the period 1977–1996 for the individual GCMs are denoted by grey bars. The 25-GCM means are shown by red solid lines and the corresponding temporal means derived from the E-OBS analyses by green dashed lines.

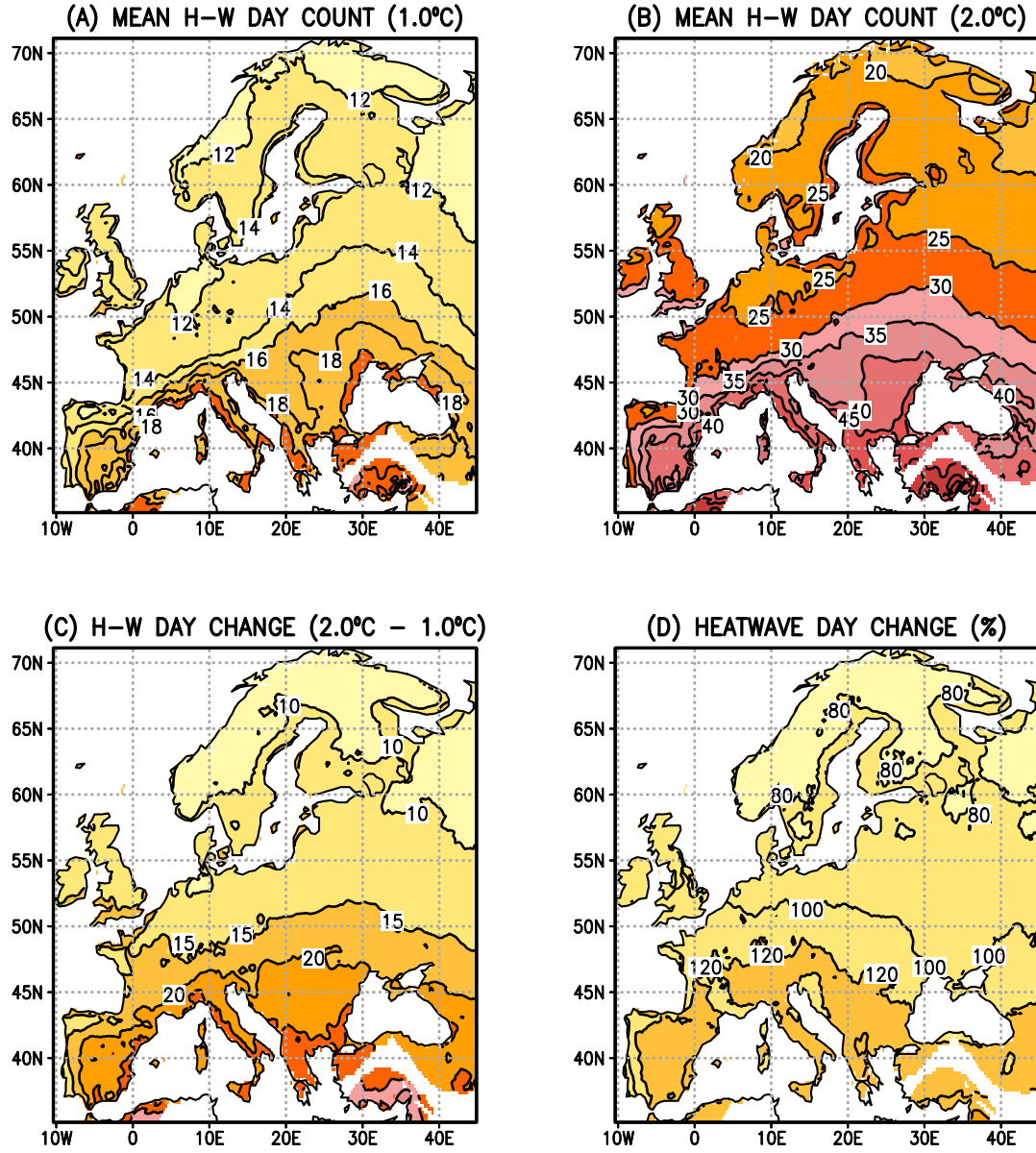


Fig. S5: The multi-model 20-year mean number of heatwave days above T_{p90} per year in Europe under the global warming levels of (a) 1.0°C and (b) 2.0°C and the projected (c) absolute and (d) percent changes in the number. Note the different contour interval in panels (a) and (b) as well as in this figure and Fig. 7 of the main text. Breaks of at most one day within a heatwave event are allowed.

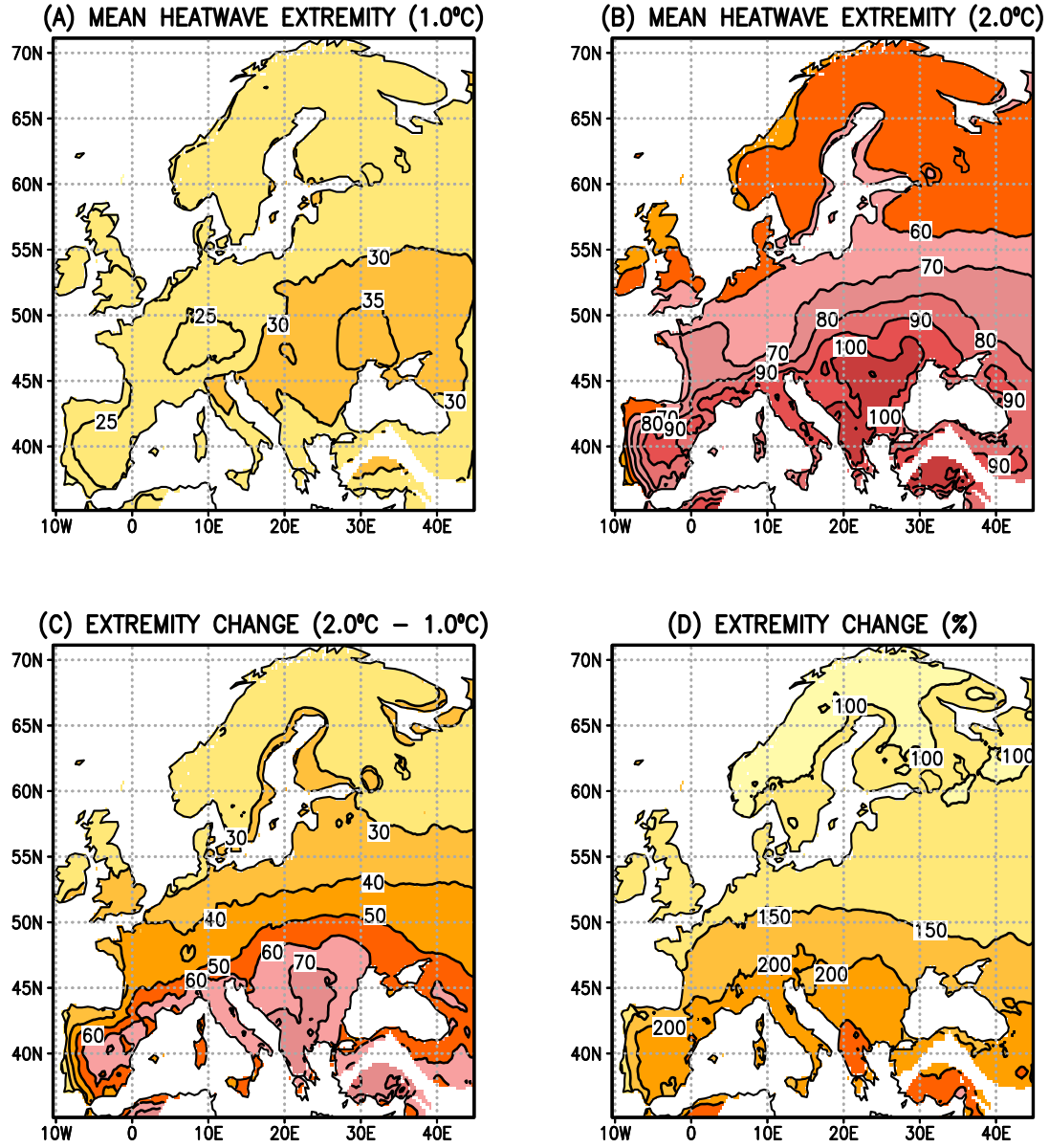


Fig. S6: The multi-model 20-year mean of the annual sum of heatwave extremity index above T_{p90} under the global warming levels of (a) 1.0°C and (b) 2.0°C and the projected (c) absolute and (d) percent changes in the index. Note the different contour interval in panels (a) and (b) as well as in this figure and Fig. 8 of the main text.

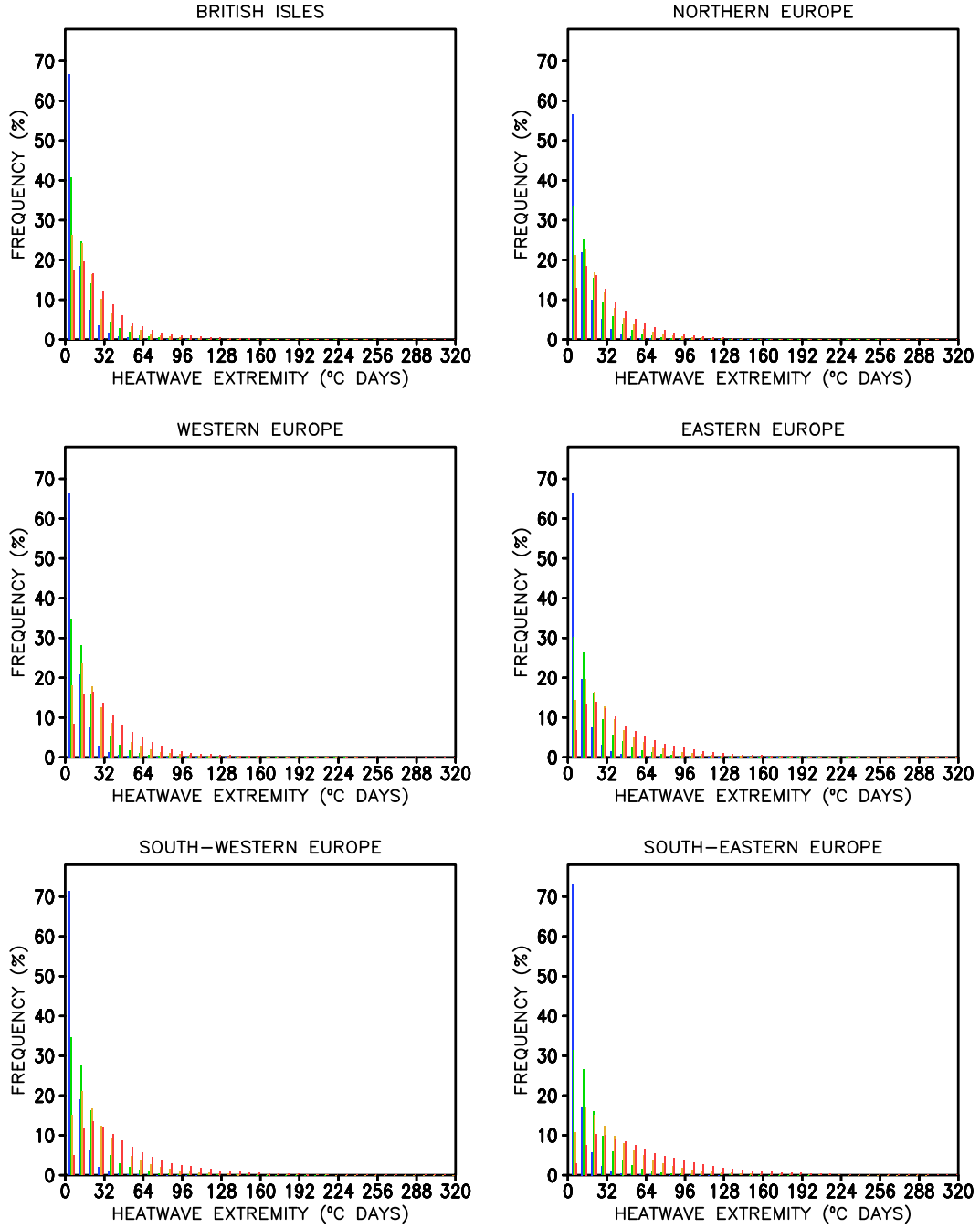


Fig. S7: Frequency distributions (in %) of the extremity index of the most intense heatwave of the year (above T_{p90} ; unit °C d) under the 0.5°C (blue), 1.0°C (green), 1.5°C (brown) and 2.0°C (red) global warming levels; multi-model means averaged over the six European sub-regions (Fig. 4 of the main text). Interrupts of at most one day in the heatwave period are allowed. The frequency classes are 0–8°C d, 8–16°C d, ... 312–320°C d.

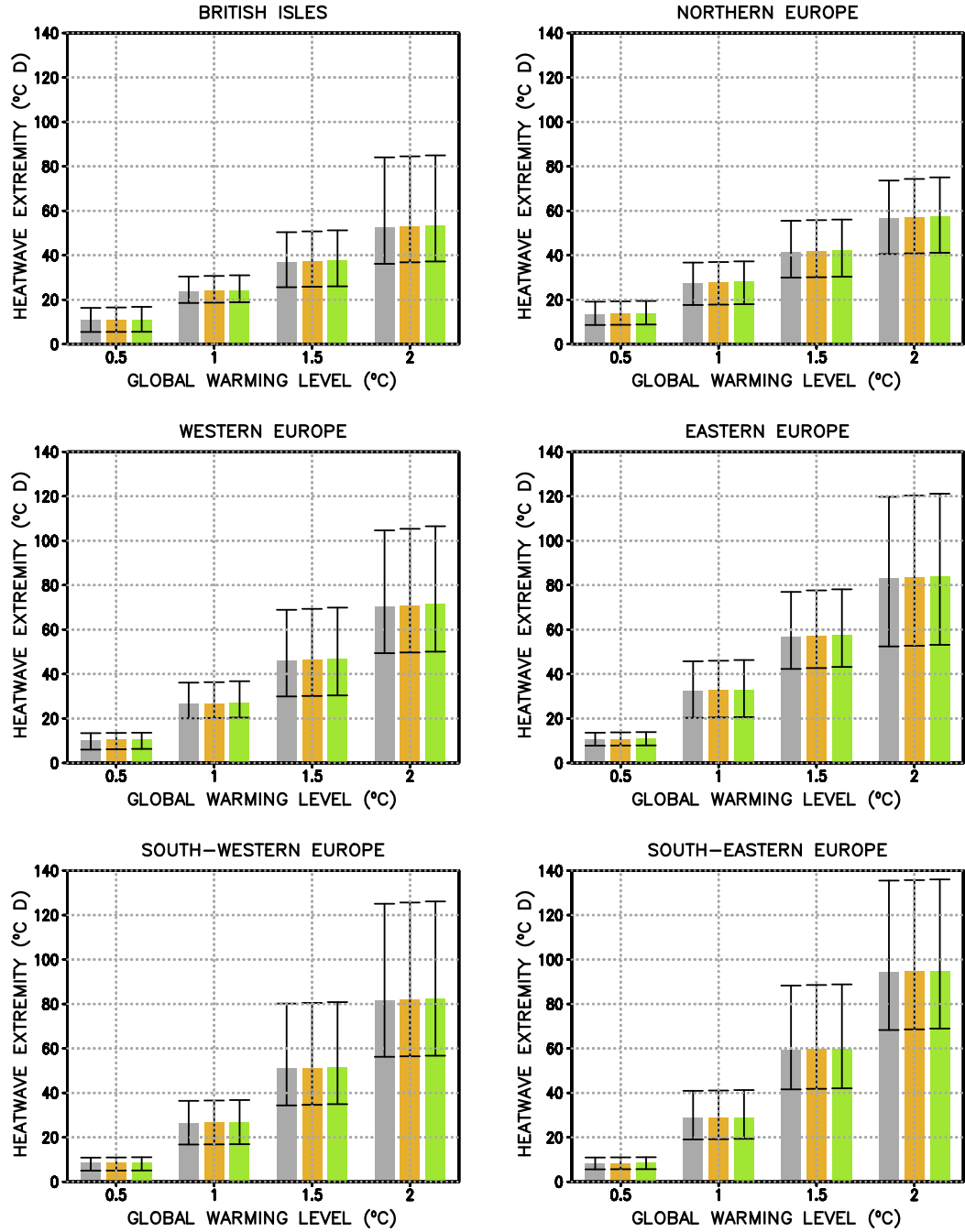


Fig. S8: The average annual sum of heatwave extremity index under the global warming levels of 0.5°C (three bars on the left), 1.0°C (the second three-bar cluster), 1.5°C (the third cluster) and 2.0°C (three bars on the right); spatial averages of the six sub-regions depicted in Fig. 4 of the main text. The left (grey) bar in the three-column cluster gives the total extremity index when using a definition permitting no breaks within the heatwave period. The mid (brown) and right (green) bars show the corresponding numbers when breaks of at most 1 or 2 days are allowed, respectively. The bars depict multi-model means, error bars the 6 to 94 % uncertainty intervals derived from the model simulations.

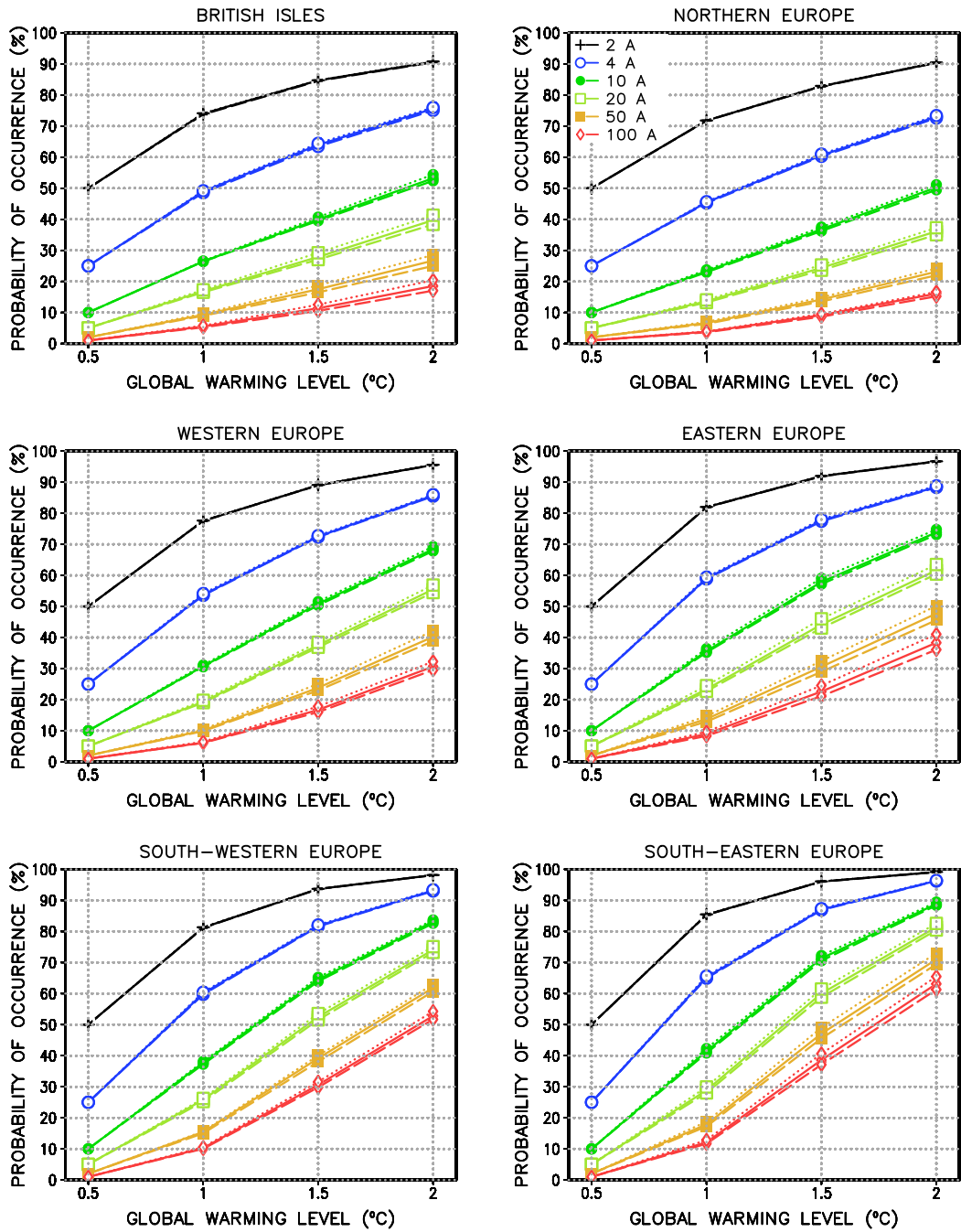


Fig. S9: Probabilities for the occurrence of an annual maximum heatwave (above T_{p90}) with an extremity index larger than that occurring once in 2, 4, 10, 20, 50 or 100 years (see the legend in the top-right panel) in the baseline climate (0.5°C global warming) as a function of the level of global warming. Probabilities derived from pooled multi-model frequency distributions are shown for the various European sub-regions. Dashed line: no interrupts in the heatwave period; solid/dotted line: interrupts of at most one/two days are allowed.

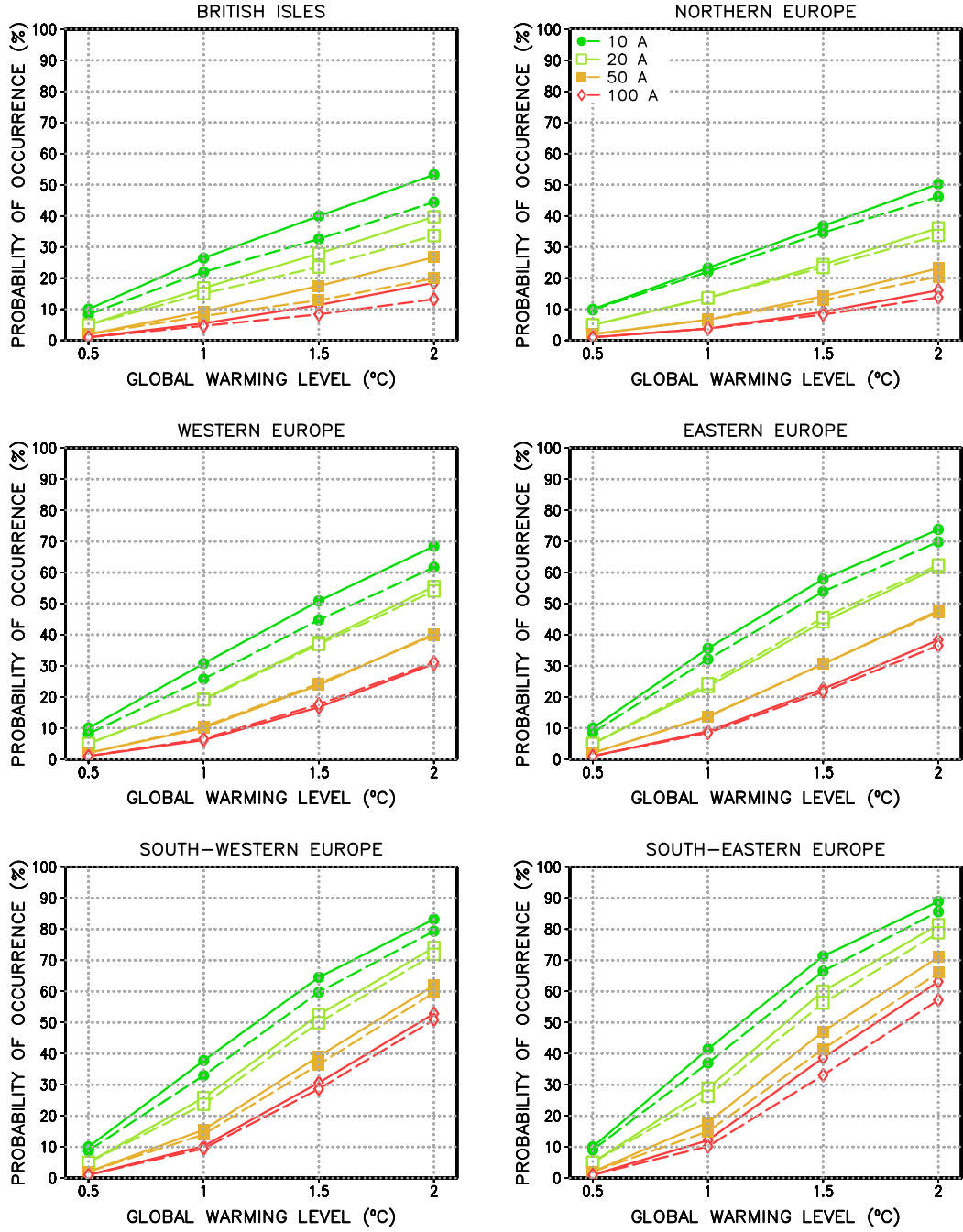


Fig. S10: Probabilities of the occurrence of an annual maximum heatwave above T_{p90} (solid lines) and above T_{p99} (dashed lines) exceeding the extremity index occurring once in 10, 20, 50 or 100 years (see the legend in the top-right panel) in the baseline climate (0.5°C global warming) as a function of the level of global warming. Probabilities derived from the pooled multi-model frequency distributions are shown for the various European sub-regions. Interrupts of at most one day in the heatwave period are allowed.

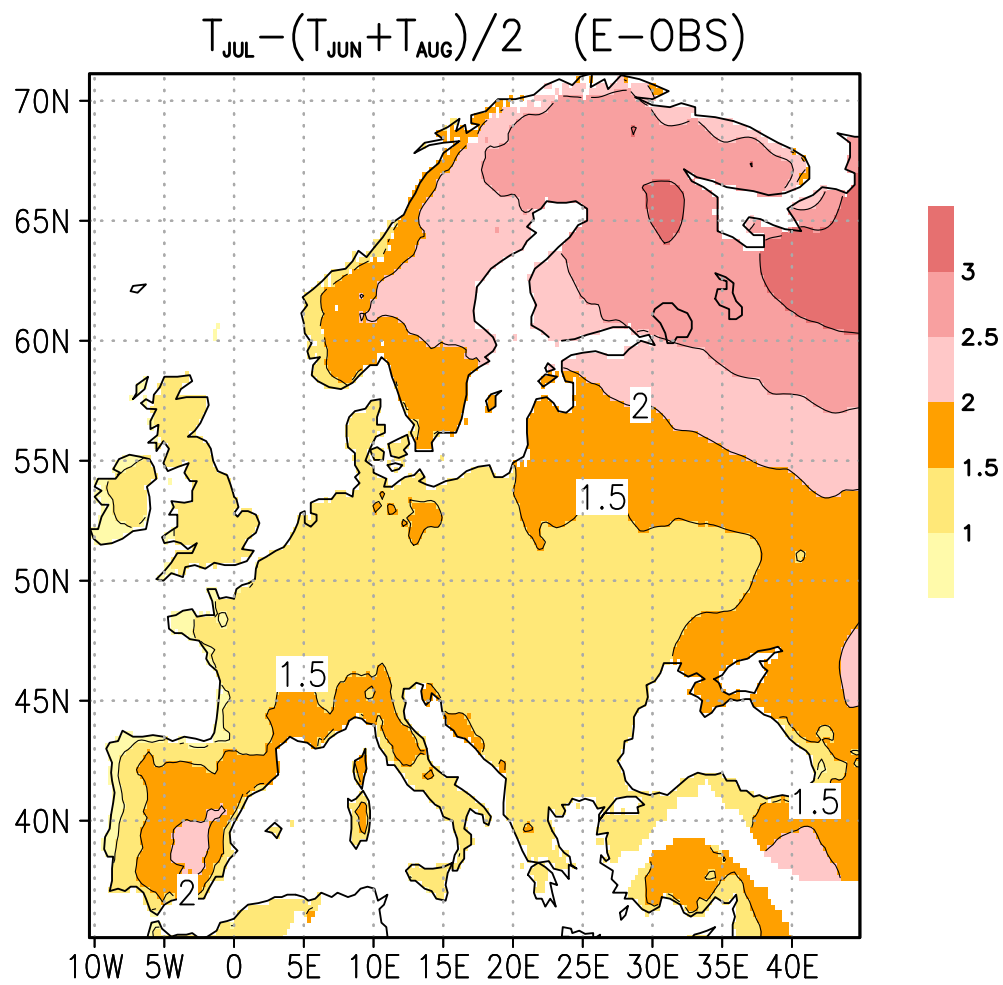


Fig. S11: The mean temperature of July minus the average of the mean temperatures of June and August derived from the E-OBS analyses.